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The world at a crossroads: Financial scenarios for sustainability

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ABSTRACT

The global financial system is a major component of our global society. The available analyses of sustainability, however, have poorly assessed the role of the financial system in scenarios of future global change. Here we contrast current global flows in the financial system with the future economic costs of a worldwide transition to renewable energies under the baseline and 450 ppm scenarios for emissions of greenhouse gases proposed by the IPCC. We show that annual global financial flows are three orders of magnitude greater than the annual economic costs of policies for global sustainability. A small global tax on financial transactions of 0.05% could thus provide the required funds for the deployment of renewable energies. To assess the roles of the financial sector in future policies for sustainability, we identified 14 key international actors and enumerated 16 key policies for sustainability that should be implemented to achieve effective global ecological and financial sustainability. We conclude that the proposed structural reforms to the financial system are essential steps urgently required for financing a global transition to a sustainable economy. Consequently, we suggest that the international scientific community should urgently pursue an academic consensus on policy recommendations for the financial sector.

1. Introduction

The financial sector plays central structural functions in the global economy, providing liquidity, channeling savings to economic agents who require financing, restricting and filtering financial resources to profitable economic activities, and creating risk-coverage instruments (Stiglitz et al., 2010). Although being a major driver of the global economy (its size is roughly equivalent to 70 times the global GDP), the financial sector stands out as anomalous, being largely poorly quantified, unregulated, and untaxed (United Nations, 2009; United Nations Conference on Trade and Development (UNCTAD), 2009). A broad and strong international consensus presently identifies the need to urgently reform and regulate the global financial system to avoid the emergence of repeated financial crises (G-20, 2011). However, despite the urgent need for a transition to an economy based on renewable energy (Hoffert et al., 2002; Paccala and Socolow, 2004; Haines et al., 2007; Peñuelas and Carnicer, 2010), the relationships between the projected reforms in the core financial sector and the needed global inversions in renewable energies remain poorly assessed and discussed.

The world is now at a complex crossroads: a multifaceted global crisis is occurring. The global crisis has humanitarian, energetic, ecological, and financial aspects. Half of the world's human population presently suffers some form of malnourishment, and famine is projected to increase in the coming decades due to a mix of water scarcity, increased energy costs, effects of land degradation, and impacts of climate change (Schade and Pimentel, 2010). In addition, the world is currently experiencing increased emissions of CO_2, increased global temperatures, widespread changes in land use, and loss of biodiversity and ecosystemic services (Intergovernmental Panel on Climate Change (IPCC) 2007a; Intergovernmental Panel on Climate Change (IPCC) 2007b). The energetic and material aspects of the global crisis are also challenging. Indeed, during the coming decades, several inputs of basic resources to the global economy will become more expensive and/or restricted, including oil (Peñuelas and Carnicer, 2010), water (Schade and Pimentel, 2010), coal (Mohr and Evans, 2009), irrigable and cultivable land (Schade and Pimentel, 2010), various raw materials (European Commission, 2010), and phosphorus (Cordell and White, 2011).

Due to the ongoing global situation, some countries have already strategically started an incipient transition to an economy based on renewable energy that will require sustained and

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Table 1
Global annual financial flows and financial costs of the deployment of renewable energies in the IPCC baseline and 450 ppm scenarios. (A) A quantification of major components of the global economic system. The annual turnover in the global foreign-exchange market illustrates the relative size of the financial sector relative to global GDP, Global Gross External Debt, and foreign exchange reserves. (B) Sustainability costs. Estimated costs are provided for the UN Millennium Developmental Goals in 2015. We also list the economic costs of policies for the deployment of renewable energy in the IPCC SRREN baseline and 450 ppm scenarios (IPCC, 2012). Global costs of subsidies for the consumption of fossil fuels are also reported. (C) Expected revenues of a 0.05% global tax on financial transactions are reported and compared to other financial sources. Maximum revenue values assume no reduction in the traded volumes. Minimum revenue values illustrate a 75% reduction in traded volumes (Stiglitz et al., 2010). The calculation of the Global Gross External Debt in section A includes the following countries: Argentina, Armenia, Australia, Austria, Belarus, Belgium, Brazil, Bulgaria, Canada, Chile, China, Colombia, Costa Rica, Croatia, Czech Republic, Denmark, Ecuador, Egypt, El Salvador, Estonia, Finland, France, Georgia, Germany, Greece, Hong Kong, Hungary, Iceland, India, Indonesia, Ireland, Israel, Italy, Japan, Jordan, Kazakhstan, Korea, Kyrgyz Republic, Latvia, Lithuania, Luxembourg, Malaysia, Malta, Mexico, Moldova, Morocco, Netherlands, Norway, Peru, Philippines, Poland, Portugal, Romania, Russian Federation, Slovak Republic, Slovenia, South Africa, Spain, Sweden, Switzerland, Thailand, Tunisia, Turkey, Ukraine, United Kingdom, United States and Uruguay.

	Variable	**Economic value (US$ trillions, $10^{12}$$)**	**Reference**
A	Global GDP 2011	70.01	International Monetary Fund (IMF) (2011a)
	Global Gross External Debt	61.50	Joint External Debt Hub (Bank for International Settlemments- OECD- World Bank and IMF) (2011)
	Gross External Debt Euro Area	15.45	
	Gross External Debt USA	14.96	
	Gross External Debt People's Republic of China	0.94	
	Foreign-exchange reserves People's Republic of China Dec 2011	3.18	Central Intelligence Agency (CIA) (2011); International Monetary Fund (IMF) (2011b)
	Foreign-exchange reserves USA Feb 2012	0.149	
	Foreign-exchange reserves Euro Area Jan 2012	0.925	
	Annual global foreign exchange market turnover	1020	Bank for International Settlemments (BIS) (2010)
B	UN Millennium Development Goals Annual Cost	0.19	United Nations Millennium Project (2005)
	IPCC SRREN Baseline Scenario		
	Annual mean investment in deploying renewable energies	0.14	International Panel on Climate Change (IPCC) (2012)
	Cumulative renewable energy investments (2011–2030)	2.85	
	IPCC SRREN 450 ppm Stabilization Scenario		
	Annual mean investment in deploying renewable energies	0.61	International Panel on Climate Change (IPCC) (2012)
	Cumulative renewable energy investments 2011–2030	12.28	
	Global annual cost of fossil-fuel consumption subsidies	0.31	International Energy Agency (IEA) (2010); International Energy Agency (IEA) (2009)
C	Annual revenue from a Global Financial Transaction Tax (0.05%)	0.64–1.83	Stiglitz et al., (2010)
	Annual revenue from a tax on foreign exchange (0.001%)	0.007	UN, (2010)
	Increased emission of IMF Special Drawing Rights	0.1–0.3	UN, (2009)
	Carbon tax (1US $/ton) in the OECD countries	0.001	UN, (2010)

Table 2
Key political actors in the policies for global sustainability associated with the financial sector.

Key actor	Mandates and roles	Actor code
United Nations system	A multilateral institution of 193 country members committed to maintaining international peace and security, developing cooperative relations among nations and promoting social progress, better living standards, and human rights. Main executive bodies include the General Assembly, the Security Council, and the Economic and Social Council. The UN system is playing a central leading role in the global transition to policies for sustainability and provides a comprehensive and legitimate multilateral environment for international policy. Indeed, policies for sustainability are currently developed by a variety of political actors such as UN conventions and advisory panels (e.g. UN Framework Convention on Climate Change, IPCC), specialized agencies (e.g. IMF, FAO, WB, ILO) and UN programs (e.g. UNDP, UNEP, WFP)	1
G-20	The G-20 promotes periodic summits of heads of state, financial ministers, and central bank governors of the 20 major economies of the world. The mandate of the G-20 is to advance policies addressing financial cooperation and stability of the international financial system. The G-20 plays a central role in making important executive decisions for the implementation of taxes on financial transactions and improved regulation of the financial system and could promote the implementation of a global reserve currency system with counter-cyclical regulatory activity. Heads of the IMF and WB regularly participate in G-20 meetings	2
National Governments/ States	Governments define national policies for sustainability and are key actors in the UN system and G-20 forums	3
International Monetary Fund (IMF)	The mandate for the IMF is to ensure global financial economic stability, promote international monetary cooperation, promote exchange-rate stability, and assist in the establishment of a multilateral system of payment. According to the UN Commission of Experts on Reform of the International Financial and Monetary System (United Nations, 2009), the IMF should play a central role in a Global Currency Reserve System based on increased emissions of Special Drawing Rights (SDRs)	4
International Financial Regulators/Supervisors	The Joint Forum of international financial regulators is an international group bringing together three main international financial regulatory entities: the International Organization of Securities Commissions (IOSCO), the Basel Committee on Banking Supervision of the Bank of International Settlements (BCBS-BIS) and the International Association of Insurance Supervisors (IAIS). The International Organization of Securities Commissions (IOSCO) is an association of organizations that regulate the world's securities and futures markets, with members in 114 countries. It promotes cooperation between National Security Commissions to promote high standards of regulation. The Basel Committee of the Bank for International Settlements (BCBS-BIS) set important global economic standards in areas such as dissemination of data and supervision of banks. The International Association of Insurance Supervisors (IAIS) represents insurance regulators and supervisors in nearly 140 countries and promotes supervision of the insurance industry and insurance markets. The Committee on Payment and Settlement Systems (CPSS) is a standard stetting body for payment and securities settlement systems.	5 6–8
	The Financial Stability Board (FSB) is an international body that monitors and makes recommendations to the G-20 about the global financial system. The FSB facilitates discussion and cooperation on supervision and surveillance of financial institutions and transactions. All these coordinated regulatory bodies are expected to improve the regulation of the financial system.	9
Main International Advisory Academic Panels	The mission of the Intergovernmental Panel on Climate Change (IPCC) is to provide comprehensive scientific assessments of the risks of climate change caused by human activity, its potential environmental and socio-economic consequences, and possible options for adapting to these consequences or mitigating their effects, including the global deployment of renewable energies	10
	The International Energy Agency (IEA) promotes research, statistics, analysis, and recommendations for worldwide energy policies and technically assists G-20 meetings	11
	The UN Commission of Experts on Reform of the International Financial and Monetary System provides advice on policies of the global financial system to the UN system bodies and other international actors	12
National/Regional Financial Regulators	The US Financial Stability Oversight Council (FSOC) identifies and monitors excessive risks to the US financial system arising from the distress or failure of large bank holding companies and non-bank financial companies, responds to other emerging threats to financial stability, and facilitates communication and coordination with other financial regulators (i.e. the Bureau of Consumer Financial Protection, US Securities and Exchange Commission, US Office of the Comptroller of the Currency, Federal Deposit Insurance Corporation, Commodity Futures Trading Commission). In a similar vein, the European System of Financial Supervision is composed of the Joint Committee of the European Supervisory Authorities, the European Systemic Risk Board (ESRB), the European Banking Authority (EBA), the European Insurance and Occupational Pensions Authority (EIOPA) and the European Securities and Markets Authority (ESMA). Similarly, all other countries have their own national financial regulators (e.g. China Securities Regulatory Commission (CSRC); China Insurance Regulatory Commission (CIRC); China Banking Regulatory Commission (CBRC), Swiss Financial Market Supervisory Authority (FINMA))	13
World Bank and Regional Development and Reserve Banks	The mandate for the WB and regional banks is to provide financial and technical assistance to developing countries for debt relief, offer programs for development and the reduction of poverty, and facilitate investment through low-interest loans, interest-free credits, and grants. Increased coordination between multilateral regional banks and their associated regional currency reserves can provide a transitional pathway to a Global Reserve Currency System (United Nations, 2009; UNCTAD, 2009).	14

efficient financial support and huge investments in infrastructure (Peñuelas and Carnicer, 2010; Jacobson and Delucchi, 2011; Delucchi and Jacobson, 2011; International Panel on Climate Change (IPCC) (2012); García-Olivares et al., 2012). However, many states sustain large debts and deficits in their budgets (Table 1) and the financial funds available for a transition to a sustainable economy are thus often scarce and insufficient. Here we analyze whether global structural reforms to the financial sector might be an ineluctable requirement for a global transition to a sustainable economy. Specifically, our aim is to compare annual flows of the financial markets and the annual financial needs of the IPCC SRREN scenarios (International Panel on Climate Change (IPCC), 2012). Subsequently, we wish to assess whether the revenues of financial taxes could effectively fund a worldwide deployment of renewable energies. In addition, we identify key international actors in the financial system and list which policies should be urgently implemented by these actors to achieve a more sustainable economy. Following the last report of the IPCC for the deployment of renewable energy (International Panel on Climate Change (IPCC) 2012) and for the sake of simplicity, two contrasting scenarios (the 450 ppm and baseline scenarios) are selected as illustrative study cases. Our main aims are to: (1) contrast the annual flows in the financial sector and the annual costs of a global transition to renewable energies in the IPCC scenarios; (2) evaluate whether financial tax revenues could effectively fund the global deployment of renewable energies and cover the costs of the UN Millennium Development Goals; and (3) identify key actors in the financial system and enumerate

Table 3
List of structural and facilitative policies for sustainability associated with the financial sector required for a global transition to renewable energies. A brief description of each policy is provided. Policies are labeled as "top-down" (T) if their implementation necessarily requires global agreements at the international level and as "bottom-up" (B) when they can be implemented at the national level. TB describes policies that allow both "top-down" and "bottom-up" approaches. Policies are also classified according to their geographical scope (Global (G)/Regional (R)). "GR" describes policies that can be implemented at both the regional and global level. Key actors that should implement the listed policies are quoted following the actor codes of Table 2.

Structural sustainability policies	Brief description	Top-down/ bottom-up	Global/ regional	Key actors
S1 Global reserve currency system	A quantitative extension of the current system of the IMF's Special Drawing Rights (SDRs). SDRs should be issued regularly and in larger amounts by the IMF (or a Global Reserve Bank). A minimum annual emission of 0.15–0.3 trillion US$ has been proposed (United Nations, 2009)	T	G	1–4
S2 Counter-cyclical regulation of a global currency system based on SDRs	The issuance of the global reserve SDRs could be an active instrument of global macroeconomic stabilization (using counter-cyclical emission with larger emissions when global economic growth is below potential). In addition, SDRs funds could be used for financing global public goods, such as policies for climate change and sustainable development and investments in renewable energy. The emission of SDRs could provide incentives for countries not to maintain high levels of surpluses, targeting the size of the annual emissions to offset the increase in non-borrowed reserves. Reserve surpluses generate macroeconomic externalities in the global economy by contributing to an insufficiency of global aggregate demand (United Nations, 2009)	T	G	1–4
S3 Global tax on financial transactions	A global tax on financial transactions is absolutely required to achieve the following objectives: (1) to promote the stability of the financial system, avoiding negative externalities generated by short-term speculative transactions and excessive exposure to risk, reducing volatility in financial markets, and reducing the need for reserves; (2) to obtain revenues to cover the costs of future financial shocks; (3) to fund policies for sustainability, including the deployment of renewable energies at the global scale (Table 1); and (4) to promote investment in productive activities, thereby increasing global aggregate demand (Stiglitz et al., 2010). All four of these objectives are indispensable in future scenarios of sustainable finances, highlighting the structural importance of global financial taxes	T	GR	1–4, 9
S3 Regional tax on financial transactions	Taxes on financial transactions can also be applied regionally or nationally, although a global application is more effective and therefore recommended (Stiglitz et al., 2010).	T	R	1–4, 9
S4 Global/Regional financial stabilization and investment funds	Significant investments will be required to make the transition to a sustainable future economy, whatever technologies may be applied (Table 1). Substantial global/regional/national funds are therefore required for the deployment of renewable energies and to finance complementary policies (Table 1). For example, other complementary funds could address the regulation of commodity prices and security of food, policies of energy efficiency, and bank deposit insurance, or cover the costs of future financial shocks (United Nations, 2009, United Nations Conference on Trade and Development (UNCTAD) 2009). Global funds should also be implemented for macroeconomic reasons: financial crises often require a coordinated global response to sustain global aggregate demand. Exporting countries experiencing high volatility in export earnings and external financial flows tend to increase precautionary savings, the accumulation of external surpluses, and foreign reserves and thereby contribute to weaken global aggregate demand. Therefore, global or national funds and coordinated Global Currency Reserve Systems may be required to solve these structural macroeconomic imbalances (United Nations, 2009)	TB	GR	1–4, 14
S5 National/Regional/Global renewable energy deployment and energy efficiency plans	Sustainable scenarios with the highest renewable energy shares reach approximately 43% in 2030 and 77% in 2050 (IPCC, 2012). This huge structural shift in the very limited time of a few decades clearly requires an important effort for the deployment of renewable energy and plans for energy efficiency. These plans should include fiscal incentives; public financing policies such as low-interest loans; research, development, and deployment of public investments; quantity-driven policies such as quotas; price-driven policies, including feed-in tariffs for electricity; and heat obligations (IPCC, 2012). Sustainable financial scenarios with precise funding mechanisms will be required to finance these elevated economic costs (Table 1)	B	R	1–4, 14
S6 UN program for the Transition to Renewable Energies and Sustainable Economy	The United Nations may consider the creation of a multilateral international program to facilitate a worldwide ordered and non-traumatic global transition to renewable energies and a sustainable economy (Peñuelas and Carnicer, 2010)	T	G	1

which policies should be implemented by each actor to facilitate and finance a global transition to renewable energies.

2. The financial sector and the global deployment of renewable energies

2.1. Annual flows and potential revenues in a taxed financial system

Table 1 contrasts annual flows in the financial sector with the financial costs of investments in global renewable energy in the baseline and 450 ppm IPCC scenarios (International Panel on Climate Change, (IPCC) 2012). The structural importance of the financial sector in the global economy is illustrated by the size of the annual turnover in global foreign-exchange markets relative to the global GDP. The annual turnover in foreign exchange in the financial markets is nearly two orders of magnitude greater than the global gross domestic product and global gross external debt (Table 1A).

Similarly, the size of annual financial flows surpasses by three orders of magnitude the annual needs of investment in renewable energy in the baseline and 450 ppm IPCC scenarios (Table 1B). The potential of the financial system as a source of public funds for a

Table 4
List of structural and facilitative policies for sustainability associated with the financial sector required for a global transition to renewable energies. A brief description of each policy is provided. Policies are labeled as "top-down" (T) if their implementation necessarily requires global agreements at the international level and as "bottom-up" (B) when they can be implemented at the national level. TB describes policies that allow both "top-down" and "bottom-up" approaches. Policies are also classified according to their geographical scope (Global (G)/Regional (R)). "GR" describes policies that can be implemented at both the regional and global level. Key actors that should implement the listed policies are quoted following the actor codes of Table 2.

Facilitative sustainability policies	Brief description	Top-down/ bottom-up	Global/ regional	Key actors
F1 Regulated network of regional reserve currency systems	A coordinated and regulated global network of diverse regional currencies has been proposed by the UNCTAD (2009). This network might in turn facilitate the transition towards a fully integrated global currency system (United Nations, 2009).	T	R	1–4
F2 Increased issuance of Special Drawing Rights	Progressively increased emission of SDRs by the IMF is a first step to a Global Reserve Currency System.	T	G	4
F3 Coordinated financial system regulation by multilateral and national financial authorities	Regulatory interventions must be varied and financial sector specific. For example, improved regulation of commodity markets is urgently needed to avoid the emergence of speculative dynamics, to stabilize commodity prices, and to avoid the emergence of global food crises. Recent wide fluctuations of commodity prices have been driven by the financialization of commodity markets (UNCTAD, 2009) and highlight the need for stricter regulative schemes. In other financial sectors, regulatory policies may address the separation of the activities of large financial institutions, particularly the separation of commercial banking from financial investment banking, the strengthening of the regulations for global bank capital and liquidity (improved Basel III agreements), or the requirement of bank counter-cyclical capital buffers.	TB	GR	4–9 13
F4.1 Detailed quantification and surveillance of financial products	Improved registration and surveillance of financial transactions (including credit default swaps (CDS), over-the-counter (OTC) derivatives and complex structured financial products) (United Nations, 2009; UNCTAD, 2009; Stiglitz et al., 2010).	TB	GR	4–9 13
F4.2 Secrecy jurisdiction quantification, surveillance and regulation	Money deposited in offshore secrecy jurisdictions has been growing at a compound rate of 9 percent annually between 1996 and 2010, a rate faster than the growth of global GDP (3.9 percent per year). Current total deposits by non-residents in offshore and secrecy jurisdictions are estimated at 10 trillion US $. Improved regulation of the global financial system requires a precise quantification of financial flows to secrecy jurisdictions (Hollingshead, 2010).	TB	GR	1–9 13
F5 Global/regional/national carbon taxes	Carbon taxes lend predictability to energy prices, thus encouraging preferential investment in low carbon-emission options. Tax revenues can provide government funds for the deployment of renewable energies. Carbon taxes are more transparent and are easier to develop and implement than complex cap-and-trade systems and are therefore recommended (Nordhaus, 2007; United Nations, 2010).	B	GR	1–4
F6 Cut on environmentally harmful subsidies	Removing subsidies for the consumption of fossil fuels (quantified in Table 1) has been strongly recommended by the International Energy Agency as an important step to all scenarios of sustainability (International Energy Agency (IEA) (2010); International Energy Agency (IEA) (2009)).	B	R	2,3
F7 Tax progressivity	In most advanced industrial countries, median wages stagnated during the last decades, thus weakening aggregate effective demand. Demand was in part maintained by financial innovation in risk management, by lax monetary policy, and by external credit facilitated by surplus countries. Tax progressivity reduces the negative effects on internal demand of rising inequality of income and provides funds to governments for sustainability and social policies and therefore may arguably be a structural part of future sustainable financial scenarios (United Nations, 2009).	B	R	2,3
F8 Tax harmonization	The use of fiscal advantages to attract foreign investors has become common with the globalization of production. However, this global fiscal scenario is not sustainable because it reduces the capacity of governments to provide public goods and policies for sustainability to the population and contributes directly to the rise in inequality through a regressive redistribution of income. Therefore, harmonization of taxes throughout the world has been advocated as a long-term but necessary goal for future sustainable financial scenarios (United Nations, 2009).	TB	R	2,3
F9 International Debt Restructuring Court	The deleveraging of government debt is required in future sustainable financial scenarios (Table 1). The creation of an international court to perform public debt audits for transparent and fair restructuring, identification of odious debts, and eventual cancellations of debts has been proposed to address this issue (United Nations, 2009).	T	G	1–4
F10 Global Economic Coordination Council	The UN Commission of Experts on Reforms of the Financial System has proposed the creation of a global economic coordination council (United Nations, 2009). It should promote accountability of all international economic and financial organizations and identify proposals for ensuring the efficient operation of the financial system. It should also promote a leading role for the financial sector in future sustainable scenarios and translate the technical solutions to the executive actors (UN Assembly, G-20, National Governments; Table 2).	T	G	1–4

global transition to renewable energies is illustrated in Table 1C. Interestingly, the annual revenues from a small global tax on financial transactions (0.05%) could cover the projected annual costs in both the baseline and the 450 ppm scenarios (Table 1B,C). Table 1 clearly highlights that a shift to a taxed global financial system could effectively finance a global shift to renewable energies and also that the UN's Millennium Development Goals could be achieved.

2.2. *Key actors in the financial system*

Which key political actors in the financial system could take an active role in facilitating and financing a global transition to a sustainable economy? Table 2 summarizes a short list of key actors and provides a synthetic description of their roles in policies for sustainability and global finance.

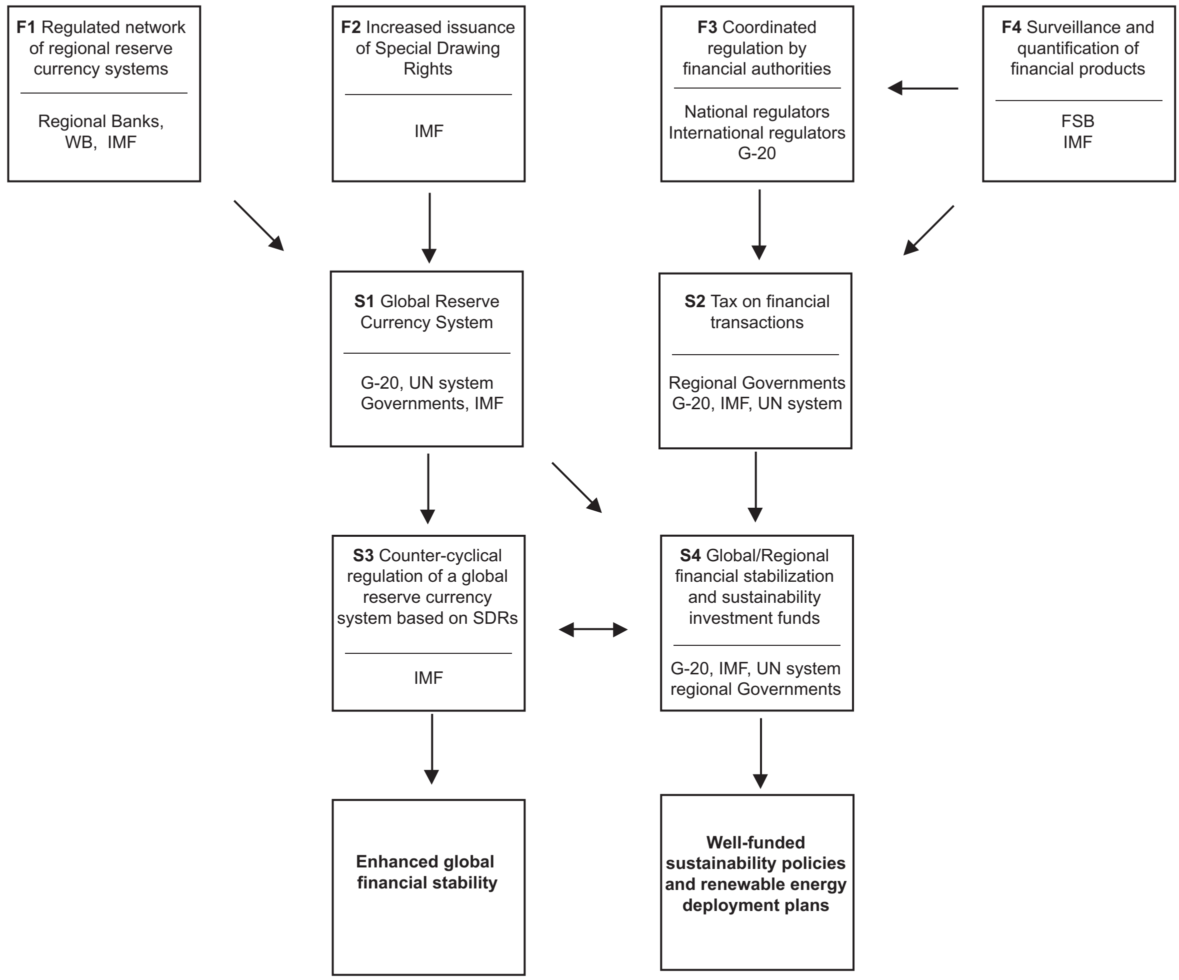

Fig. 1. An illustration of the sequential implementation of facilitative and structural policies in the financial sector. Boxes include policies for sustainability and finance and key international actors. In each box, the key actors associated with specific policies are located below the horizontal line.

We have reviewed three basic profiles of international actors: (1) executive actors, which are mainly linked to decision making and legislation (e.g. the UN General Assembly, G-20, national governments); (2) financial actors, which play key roles in financial regulation (i.e. IMF, WB, FSB, international and national financial regulators); and (3) advisory academic panels, which are associated with the generation of applied knowledge for policies for sustainability and finance and the formulation of precise recommendations to the executive actors (i.e. IPCC, IEA, UN Commission of Experts on the Financial System, Table 2). Crucially, coordinated and determinate action from all these actors is currently needed for a global transition to renewable energies and policies for sustainability.

Which specific policies for sustainability should actively promote each of these actors? Tables 3 and 4 list 16 key policies for sustainability and associate each policy to the political actors described in Table 2.

Fig. 1 illustrates how these policies could be applied in a sequential order. We have identified facilitative (F) and structural (S) policies (Tables 3 and 4). Facilitative policies are initial actions, or first-step policies, currently needed to initiate changes in the regulation and structure of the financial system (i.e. F1–F4 in Fig. 1). If successfully implemented, facilitative policies would allow the implementation of more structural reforms in second-step policies (i.e. S1–S4 in Fig. 1). For example, it has been previously stated (United Nations, 2009; UNCTAD, 2009) that both the implementation of systems of reserve currency at the regional scale (Fig. 1, F1) and an increase in the emissions of Special Drawing Rights by the IMF (Fig. 1, F2) would greatly facilitate the subsequent establishment of a Global Reserve Currency System (Fig. 1, S1). Once achieved, this Global Reserve Currency System could in turn be counter-cyclically regulated (Fig. 1, S2), stimulating global aggregate demand during economic crises and providing enhanced global financial stability (United Nations, 2009). Similarly, increased regulation of the financial system (F3) and improved surveillance and quantification of financial products (F4) have been identified as basic initial steps to allow a global tax on financial transactions (Fig. 1, S3) (Stiglitz et al., 2010). In a third sequential step, the revenues of this global tax (Table 1) could provide funds devoted to maintain financial stability and to allow the global deployment of renewable energies (Fig. 1, S4).

3. Conclusions

The huge economic size of the financial sector (Table 1) suggests that it deserves specific consideration in the design of policies for global sustainability, as in the energy and transport sectors (Peñuelas and Carnicer, 2010). Moreover, the influence of financial networks on all economic sectors is widely acknowledged and thus partly drives the dynamics of the entire economic system (Stiglitz et al., 2010). A specific role for the financial sector, due to its central economic importance (Table 1), in a global transition to sources of sustainable energy is required. Moreover, the societal capacity to rapidly and effectively respond to global challenges may crucially depend on both the deployment of sufficiently large financial funds and the implementation of key reforms to the financial system. Among the proposed key reforms, we highlight that even a minimal tax on financial transactions (0.05%) could finance a global shift to renewable energies and could also provide the needed resources to fund financial stability. In addition to providing basic funds for financial stability and policies for sustainability, a global financial tax would also reduce volatility in the financial markets and increase inversion in productive activities in other economic sectors. Similarly, implementing a counter-cyclically regulated global reserve system could provide substantial funds for policies for sustainability, enhancing at the same time the stability of the financial system. Obviously, the four structural core policies described (S1–S4) may be complemented by other policies, such as the suppression of subsidies on the consumption of fossil fuels, the implementation of carbon taxes, improved surveillance of secrecy jurisdictions, and the implementation of ambitious national plans for the deployment of renewable energies and the increase in energy efficiency, among other initiatives (Table 1; Nordhaus, 2007).

Critically, the economic costs of policies for sustainability may increase during the coming decades. For example, energy returns on energy investments (EROEI) are projected to progressively decline (García-Olivares et al., 2012), which could progressively increase the costs of policies for sustainability. Similarly, the costs of basic raw materials and energy are projected to increase during the coming decades (International Energy Agency (IEA), (2010); International Energy Agency (IEA), (2009); Peñuelas and Carnicer, 2010; García-Olivares et al., 2012). The negative effects of increased costs of energy and raw materials might be to some extent compensated by the reported decreasing costs for deploying renewable energy due to industrial advances (International Panel on Climate Change (IPCC), 2012). The projected rising costs of fossil fuels, however, indicates that the optimal political time for implementing structural reforms in the financial system might be now. These structural reforms should include the taxation of the financial system and the provisioning of public funds for policies for sustainability (Table 3). In other words, an early regulation and taxation of the financial sector is highly recommended due to possible increasing costs for energy and declining EROEIs in the near future, which would in turn increase the economic costs of globally deploying renewables. In line with these arguments, we suggest that the proposed structural policies in the global financial system (summarized in Tables 3 and 4) could be discussed and eventually implemented by the G-20 and the UN Assembly. In addition, the international scientific community should urgently open a debate on the financial aspects of global policies for sustainability and pursue a broad academic consensus on basic policy recommendations. We firmly conclude that financial structural reforms (Tables 3 and 4) are required for effectively financing a transition to a sustainable economy. We suggest that these policies deserve more attention and should be considered and discussed by the scientific community.

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